

Cutting machine for organic plant materials, especially for tobacco

This invention relates to a cutting machine for organic plant materials, especially for tobacco.

A cutting machine of this type is known from the Polish patent application Pl 347 304 as well as from patent applications US 4 364 402 and US 4 467 970, EP 584 524, GB 2 105 578, DE 3 127 697 and 3 222 433, the machine comprising a frame and a cutterhead mounted in the frame, the cutterhead being in the form of a drum having cutting knives symmetrically arranged on its perimeter surface, the cutterhead being arranged on a drive shaft driven by a belt transmission, the shaft being coupled by a coupling mechanism with the main worm gear which is connected, by means of an articulated shaft and a conical gear, to a driving wheel, the wheel, by means of a driving chain, driving chain wheels mounted on knife extension rollers, the rollers directly driving the knife extension arrangement through another

subsequent worm gear.

However, operation of these known cutting machines is based on the registration of the torque of the main cutterhead drum drive, on which extension of the knives is dependent (mechanical gear).

According to the invention, the cutting machine for organic plant materials, especially for tobacco, comprising a frame and a cutterhead mounted in the frame, the cutterhead being in the form of a drum having cutting knives symmetrically arranged on its perimeter surface, the cutterhead being arranged on a drive shaft driven by a belt transmission, the shaft being coupled by a coupling mechanism with the main worm gear which is connected, by means of an articulated shaft and a conical gear, to a driving wheel, the wheel, by means of a driving chain, driving chain wheels mounted on knife extension rollers, the rollers directly driving the knife extension arrangement through another subsequent worm gear, is characterised in that the cutterhead comprises two separate knife extension arrangements arranged alternately to each other below the perimeter surface of the cutterhead drum and actuated separately, preferably by two separate slideable coupling subassemblies co-operating with corresponding two main worm gears arranged on both sides of the cutterhead, each of the two knife extension arrangements being connected to the corresponding cutting knives and equipped with a separate electric driving mechanism comprising

an electric motor, revolutions of which being controlled by means of an external signal independent of parameters of the cutterhead drum motion, the signal being transmitted and adjusted by electric motors by means of an electric signal specifying the required extension rate of the appropriate knives set, the motors being arranged axially symmetrically on both sides of the drive shaft.

Preferably, the cutting knives are grouped into two separate functional sets of the cutting knives, linked with the corresponding knife extension arrangements by means of two driving chains placed on both sides of the cutterhead drum, the successive cutting knives in these two functional sets being arranged alternately to each other along the perimeter surface of the cutterhead above the corresponding knife extension arrangement, and, moreover, each of the functional sets comprises  $2^{|n|}$  single cutting knives, where  $|n|$  denotes the absolute value of an integer.

The invention is illustrated by the embodiment shown in the accompanying drawing, in which:

Figure 1 shows a cross-sectional view through the cutterhead of the cutting machine according to the invention,

Figure 2 shows a side view seen from one side of the cutterhead of the cutting machine according to the invention,

Figure 3 shows a side view seen from second side of the cutterhead of the cutting machine according to the invention,

Figure 4 shows a perspective view of the cutterhead of the cutting machine according to the invention.

Figure 1 shows a cross-section through the cutterhead of the cutting machine according to the invention, mounted on the main drive shaft 15 placed within the frame 12 and driven through the driving wheel 11. Stepping motors 1, 1a are located on the main shaft 15 symmetrically on both sides of the cutterhead, the motors being separately controlled and being provided for separate driving each of the knife extension arrangements, 10, 10a, placed symmetrically on both sides of the cutterhead. The torque required for extension of the knife 16, 18 is transmitted from the electric motors 1, 1a through the worm gears 2, 2a. Figures 2 and 3 show views of the cutterhead from both sides, illustrating the double-sided transmission of power from the worm gears 2, 2a through the articulated shafts 3, 3a and the conical gears 4, 4a to the driving chain wheels 5, 5a which, by means of the driving chains 6, 6a, drive the chain wheels 7, 7a directly driving the knife extension rollers 8, 8a, which are shown also in figure 1. Tensioning chain wheels 13, 13a are used to optimise tension parameters including the wrapping angle of the driving chains 6, 6a, situated as shown in figure 2, as well as chain wheels arrangements increasing the wrapping 14, 14a. It is to be noted that the driving chain wheels 7a are slid over onto the extension rollers 8 from one side of the cutterhead drum and the chain wheels arrangements 14 increasing the wrapping

are slid over from the other side, whereas the driving chain wheels 7 are slid over onto the extension rollers 8a from one side of the cutterhead drum and the chain wheels arrangements 14a increasing the wrapping are slid over thereon from the other side. As shown in figure 4, cutting knives 16, 18 are arranged on the perimeter of the rotary cutterhead drum.

Figure 4 shows the worm gears 9, 9a located on the extension rollers 8, 8a, the worm gears driving directly the both separate screw knife extension arrangements 10, 10a. The illustrated embodiment enables separate extension and separate control of extension parameters of the both knives sets 16, 18, maximum 8 knives in each, coupled with the corresponding knife extension arrangement 10, 10a. As already described above, the cutterhead of the cutting machine according to the invention comprises two separate knife extension arrangements 10, 10a placed alternately to each other below the perimeter surface of the cutterhead drum. The two separate knife extension arrangements 10, 10a are separately actuated by means of two separate slidable coupling subassemblies 17, 17a located on both sides of the cutterhead drum, co-operating with the two corresponding main worm gears 2, 2a placed on both sides of the cutterhead. The first separate knife extension arrangement 10 is connected to the cutting knives 16 and the second separate knife extension arrangement 10a is connected to the cutting knives 18. Both arrangements 10, 10a are equipped with separate driving mechanisms comprising

electric motors 1, 1a having revolutions controlled by means of an electric signal specifying the required rate of extension of the appropriate knives set. The electric motors are arranged axially symmetrically on both sides of the drive shaft 15.

The knives 16, 18 are grouped into two separate functional sets of cutting knives coupled to the corresponding knife extension arrangements 10, 10a by means of two driving chains 6, 6a located on both sides of the cutterhead drum. The successive cutting knives 16, 18 in these functional sets are placed alternately to each other along the perimeter surface of the cutterhead, above the corresponding knife extension arrangement 10, 10a. Each of the separate functional sets of the cutting knives preferably comprises  $2^{|n|}$  single cutting knives 16, 18, where  $|n|$  denotes the absolute value of an integer.

Preferably, the cutting knives are grouped and extended during operation according to the following series: 16 or 8 or 4 or 2 or 1. The series satisfies the general formula:  $2^{|n|}$ , where  $n$  is an integer. The illustrated embodiment, in which 8 knives are used, enables operation of the cutting machine in three operational modes of the worm gear 2 or 2a, the modes being selected by appropriate operational coupling of the selected one or two worm gears 2, 2a by shifting the coupling subassembly 17, 17a.

At most 8 cutting knives of the knife extension arrangement 10 are extended (active) in the first mode, the second set of at most 8 cutting knives of the knife extension arrangement 10a being not extended and being left in the waiting (stand-by) mode.

The second set of at most 8 cutting knives of the knife extension arrangement 10a are extended in the second mode, the previous set of at most 8 cutting knives of the knife extension arrangement 10 being retracted to the waiting (stand-by) position and being left not extended (inactive).

Both sets of at most 8 cutting knives of both knife extension arrangements 10, 10a are extended so that the number of extended (active) knives on the perimeter satisfies the condition of the above mentioned series.

Each set of the cutting knives 16, 18 comprise its separate driving mechanism, which is driven by the electric motor 1, 1a. Digital control of operational parameters of such motor enables precise, unequivocal and reliable coupling one or both the knife extension arrangements 10, 10a so that the cutting edges of the active knives sets 16 and/or 18 are located at the precisely defined surface of a cylinder required by the device's operational parameters, the axis of rotation of the cylinder being the same as the axis of the cutterhead, and the extension rate of all the active knives 16 and/or 18 being the same.

When the active (the first one) cutting knives set 16 are extended by the knife extension arrangement 10, the second cutting knives set 18 are in the inactive waiting mode and the cutting knives 18 are not extended. If the active cutting knives set 16 happen to be damaged and/or need to be replaced, then the solution of the invention enables automatic retraction of the active cutting knives set 16 to the inactive position and automatic extension (activation) of the second cutting knives set 18. Also possible is simultaneous activation of both cutting knives sets 16, 18. The above operations may also be carried out manually.

The illustrated cutting machine enables precise and independent of the rotational speed of the cutting machine drum extension of at least one set 16, 18 of knives cutting the tobacco material, the knives being arranged on the perimeter of the rotary cutterhead drum, both for cutting the tobacco material as well as for cleaning and sharpening the knives 16, 18 after an operation cycle.